ECET SENIOR DESIGN PROJECT REPORT

DivSys CMM (coordinate measuring machine)

Submitted to

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by

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Coordinate Measuring Machine

ABSTRACT

This report will be about how we were able to repair a non-functioning coordinate measuring machine that hasn't been working for four years. In the report, it will talk about the design overview of the PC that DivSys decided to use for a different project and how we got the coordinate measuring machine that is owned by the company DivSys to work again. The report will also talk about the construction, cost, terms, parts, coding and testing phases of the coordinate measuring machine, PC, and the machine's electrical components of the project.

Coordinate Measuring Machine

TABLE OF CONTENTS

Coordinate Measuring Machine

REVISION HISTORY

Version	Date	Revised by	Description
1.0	29 March 2017	Eltjon Hasani & Zach Eggleton	Initial version
2.0	10 April 20xx	Eltjon Hasani & Zach Eggleton	Add Justification

Coordinate Measuring Machine

1. INTRODUCTION

This report is going to be the reflection of the project through last semester and this semester of all the work and planning that went into designing, building, and testing the PC and getting the coordinate measuring machine to work again like it did before with the PC. The report will talk about how we got the PC to work again with the View Metrology Software and how the software works with the CMM. It will also talk about how we got the CMM machine working again and how we find out that the PC was not the only problem with the CMM machine but it's hardware had problems too.

The user should not need any new learning on how to use the software or the coordinate measuring machine if the user had past experience because it should work the same way. The user should notice a difference in speed and performance because the CPU and Ram both have been upgraded and the motherboard was replaced.

1.1 Justification:

The CMM project draws from 300 to 400 levels because first we needed to replace a computer and the HETM-40200 class taught how to build a computer and how to install software like windows and set up cabling. Next we had to learn how the programming software talks with the existing hardware of the CMM and the ECET 30900 class taught us how to look things up in software to find out how to get the Hardware to work with the software. And last ECET 35100 taught us the basic concepts and terminology of instruments and how software and hardware work together to get the information and that is something we had to understand to make the CMM work and we had to use a language program that works like LabVIEW and 35100 helped us with that. This project is rigorous enough to be a capstone project because it shows we meet the CPET outcomes because we had to Identify, analyze and solve technical problems, apply and design software programs and be function as a member of a team for this project.

1.2 Problem Statement:

The View Metrology Software is not working anymore and is giving errors and the CMM machine will not move at all and will not turn on anything including the camera and will not measure. The goal for the project is to build a PC that will work with the VIEW Metrology Software and talk to the CMM machine or find a way to get VIEW Metrology Software to work on the old PC and talk to the coordinate measuring machine just like before and it is expected to perform according to the DivSys expectations.

Coordinate Measuring Machine

1.3 System overview: The purpose of the CMM machine is to get accurate measurement of the item that is being scanned on it to make sure the item is the right size and will fit for what is needed before a company ships off the item to their customers or use the item to assembly something. The CMM machine we fixed DivSys is planning on using it to measure circuit boards that they make, to make sure the circuit boards are the right measurements before they send it off to the customers. This machine uses X, Y, and Z axis to do the measuring using a camera you can see in the View Metrology Software interface and a laser that the light on it can be changed to white, red, blue, or green to get better a measurement. The way the machine works is it scans every circuit board on it and measure it and see if it matches the given measurements if it does it will display pass and the measurement on the result page of the interface if it does not match it will display a fail and the measurement it received when it scanned the board.

Coordinate Measuring Machine

2. REFERENCED DOCUMENTS

Table 1: Reference Documents

Title	Document Reference Number	Comment
TimeLine	Eltjon&Zach_ECET49100_Timeline	Submitted 02/24/2017
Functional Specification	Eltjonhasani_ECET4900_Functional Specification	Submitted 01/13/2017
Design Tradeoffs	Eltjonhasani_ECET4900_Design Tradeoffs	Submitted 01/13/2017
Project Proposal	EltjonHasani4900-proposal	Submitted 01/13/2017
Low Level Design	Eltjon&Zach_ECET49000_Low-Level Design	Submitted 01/13/2017
High Level design	Eltjonhasani_ECET4900_High-Level Design	Submitted 01/13/2017
Test plan	Test Plan	In Draft
Software Interface	Software Interface	In Draft
Cost	Cost	In Draft
CMM flow chart	CMM flow chart	In Draft
VIEW Metrology code	VIEW Metrology code	In Draft

Coordinate Measuring Machine

3. SYSTEM-WIDE DESIGN DECISIONS

The project was to get the CMM machine to work as it did before. The decision was made to replace the computer all together by building a new computer that would run with the old computers hardware that talks to the CMM machine by doing that it would last longer and can easily be fixed in the future as needed and so it would work faster than the old computer so more work can be done in a day.

- The first Design decisions was to get a new Motherboard, RAM, CPU, Hard drive for more memory because the old one only had 32mb, and operating system to upgrade from windows 2000 to windows 7 as request by DivSys for the new computer and install the old graphic cards that runs the CMM machine.
- Cost for new software was to high so the decision was made by DivSys to use the new computer on another machine they have and to go back to the old computer with windows 2000 and get the CMM machine to work with it.
- We rebuilt the old computer but set it up to the internet to update and reinstall VIEW Metrology Software so it talks to the CMM machine again.
- Replaced one of the CMM machines burned out power supply as seen in image 1 to turn on the CMM machine but it was getting 190 voltage and that was to much voltage for the 100VAC to 120VAC range that it would burn out the new power supply.
- It was to low of a voltage for the 200VAC to 240VAC as seen in image 2 range to turn on the machine so the decision was made to rewire the power supply to get voltage directly from the outlet to get the 200V it needs.
- The XYZ axis of the CMM was not getting any power even after we replaced the power supply so we decided to trace every wire inside the CMM machine to see where the XYZ axis of the machine leads and we figured out it was the relay seen in image 3 after doing some research we found out the relay was wired wrong and we rewired it to get the XYZ axis working again.

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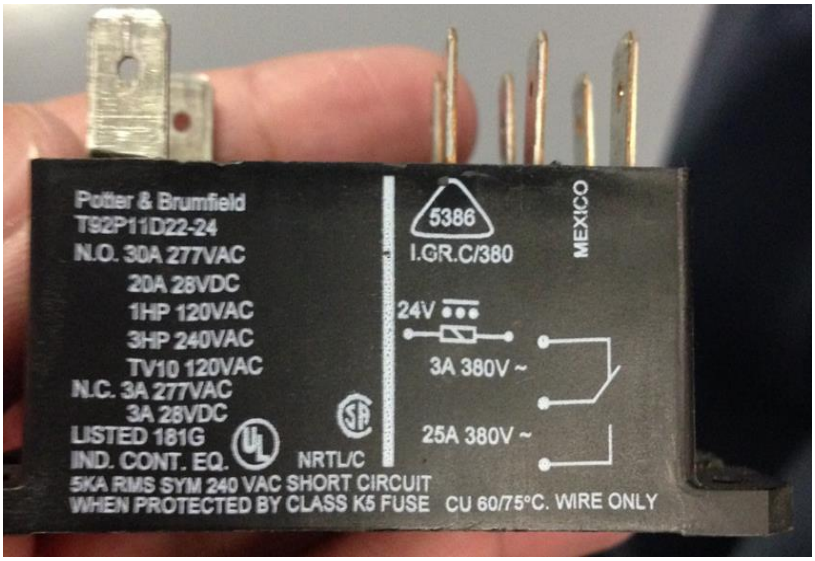
Image 1

Image 2

Image 3



Coordinate Measuring Machine

A. Required Specifications

Below are the guidelines that should be achieved with this project when it is complete.

1. The new PC components that are installed must have a long service life
2. Easily be fixed in the future if needed
3. Windows 2000 should work with the VIEW Metrology Software
4. PC should be faster and working with old components
5. Talks to the CMM machine hardware
6. CMM machine should receive the right information from the PC
7. The new PC should work the same way as the old one so no learning is needed
8. CMM should be measuring the circuits boards right and given right results

B. Analysis Overview

Many items where needed to make a working PC that would talk to the CMM machine so just buying a new PC would not work because the old PC had custom built parts in it that where needed to talk to the machine. To make a new PC talk to the hardware we had to use the new PC components and the old PC components that where custom built and built our own PC that would work with the new components and the old components together. Reliability was also a big part because the new PC must talk to the CMM hardware and PLCs at all times when information is entered into the PC so work does not slow down. Availability was also a big part to the company because the PC

should be compatible with the old software that runs the machine and be able to keep up with the demands of the software without stuttering or freezing, as well as being easy to fix for any future maintenance.

C. Critical Items for the new PC

The custom-built parts are hard to found or even get at all so we had to put a large amount of time on the components we are buying to ensure the old components can work with the new components like our motherboard before we installed them together to make sure the custom-built parts do not get damaged in any way. Once the installation is completed the PC is expected to perform to the company's expectations level and that no new learning will be needed to use the CMM because it should run the same way as the old PC the only difference should be the updated operating system to Windows 7 as the company requested and the communication between the PC and the CMM machine should be 100% reliable.

Coordinate Measuring Machine

4. Hardware

(CMM)coordinate measuring machine = "measures the surface area of three-dimensional objects and often used during the inspection phase in the manufacturing process" (http://study.com/articles/How_to_Become_a_CMM_Programmer_Education_and_Career_Roadmap.html).

Motherboard =" physical arrangement in a computer that contains the computer's basic circuitry and components" (http://whatis.techtarget.com/definition/motherboard).

(Ram)Random-access memory =" the place in a computing device where the operating system, application programs and data in current use are kept so they can be quickly reached by the device's processor" (http://searchstorage.techtarget.com/definition/RAM-random-access-memory).

(CPU)Central Processing Unit=" responsible for interpreting and executing most of the commands from the computer's other hardware and software" (https://www.lifewire.com/what-is-a-cpu-2618150).

(OS) operating system =" software that controls the operation of a computer and directs the processing of programs" (http://www.merriam-webster.com/dictionary/operating%20system).

Hard drive= is where all the data is stored and where you can find your files and folders you saved or created.

Coordinate Measuring Machine

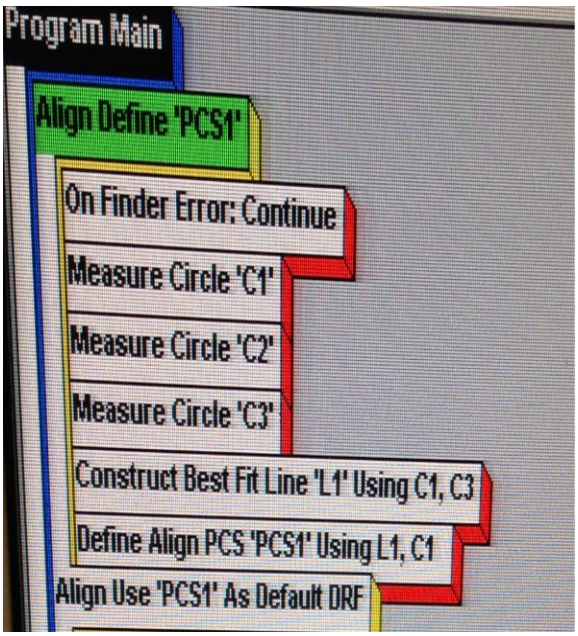
5. Software This section will identify the software that the CMM needs so it works , it will also talk about a code DivSys uses for one of their circuit boards.

VIEW Metrology Software (VMS™) = it's the feature-oriented programming the PC uses to work with the CMM machine

Elements 3.0 for windows 2000 XP = used like AutoCAD to make printed circuit boards or measure circuit boards.

Image 4 blow is part of DivSys VMS code for a fixture alignment program for one of their circuit boards that starts the program to measure the circuit board. The code gets the CMM machine to measure but the on-finder Error: Continue line of code you see in image 4 makes sure you point the camera on a circle to measure then it will move through the code from measure Circle 'C1' to 'C3' for you to set after circle 3 you have set the fixture they have on the machine and will start measuring every circuit board on the fixture. The full code can be seen in image 8 and 9 in the appendixes section of the report.

Image 4



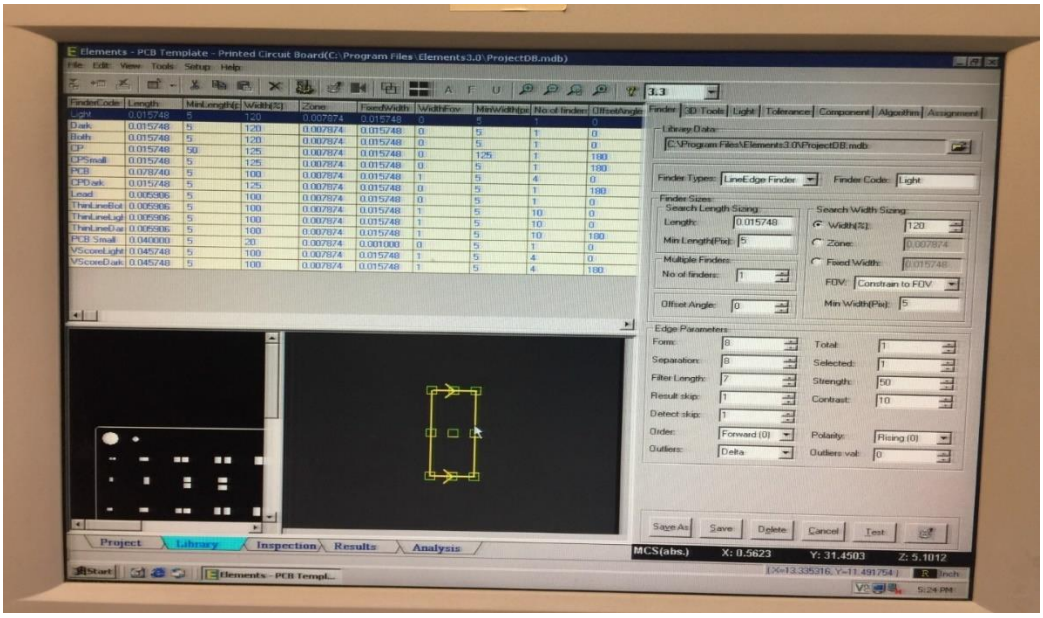
Source: DivSys

Coordinate Measuring Machine

6. Software Interface

Image 5 below is the Element software interface on the top left handle of the image is the screen you enter the information about the circuit board. On the right side of the image is where information like the finder, tolerance, and other things can be entered. You can also find tools on their that you can use like 3D tools, control the light of the machine and others like algorithm to help you measure your circuit boards. In the lower left side of the image is where you can define things on your circle board like circle and make your circle board on and the screen next to it shows the shape of your circuit board and how its located. After you set things how you like you can go to the inspection tap and run the program and you can see on that screen live pass fail results. The result like the measurement data and if it passed or failed are showed in the results tap.

Image 5

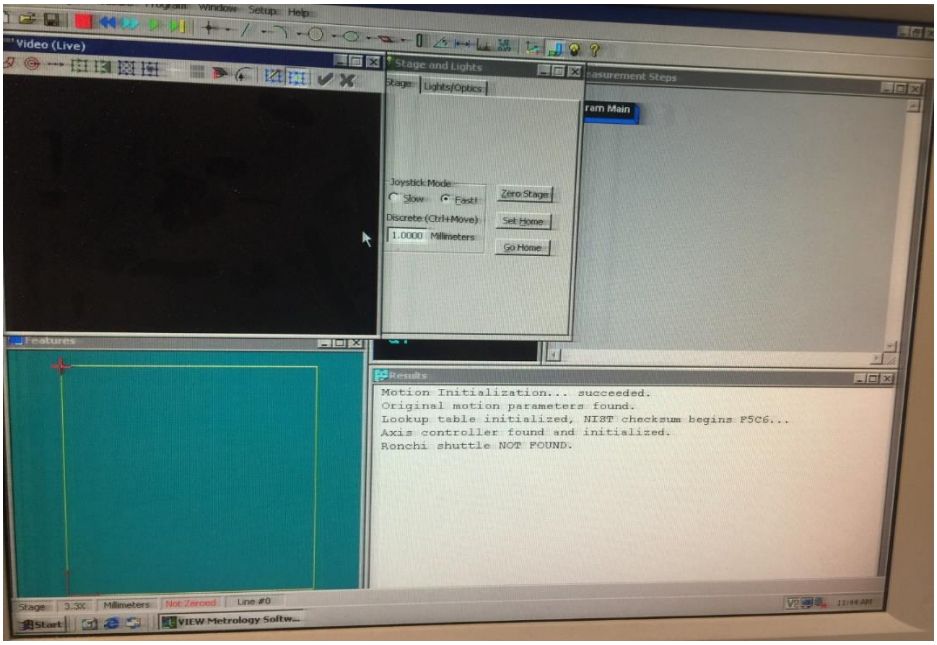


Coordinate Measuring Machine

The VIEW Metrology Software interface is showed in image 6 below. This is the software DivSys mostly uses because it is the more sample one to use. The screen on the left top side of the image is where you can see a live video of your circuit board from a camera the CMM machine has. That same screen also is used with the other screen on the right side of the image to program the code like the code example to create a fixture alignment from DivSys from image 4 above. The way it works is you select the align use step of the alignment block in the measurement step window next you select Align/System alignment from the menu the click new button and enter a name for the fixture and a block of code like in image 4 above appears then you click on a shape on the video screen like a circle double click on the video screen when you find a circle to set it up and you do all of that again until your fixture is set. T

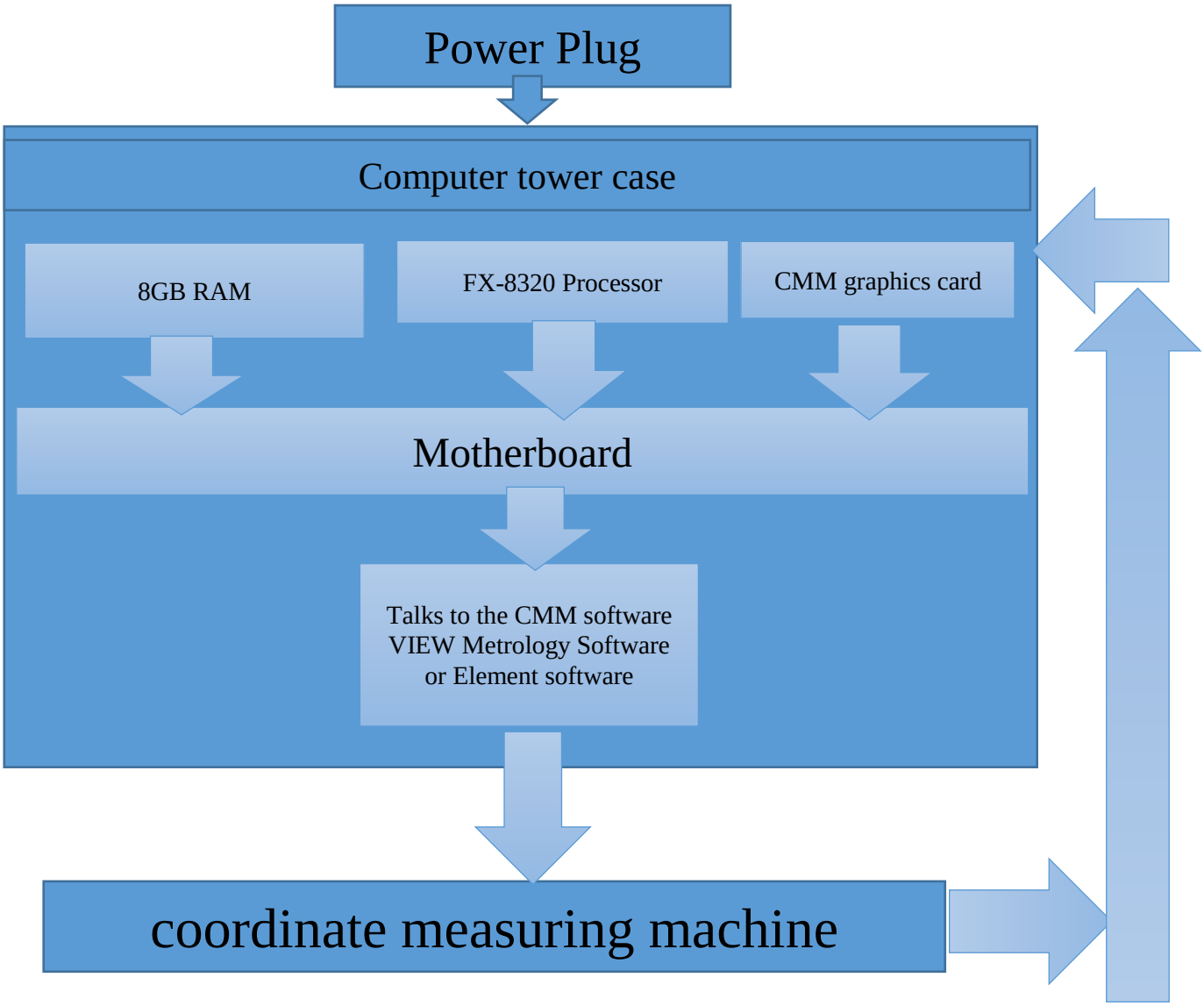
The screen on the lower left side of the image tells you where your fixture is located on the CMM machine. The lower right screen on the image is where all the results like if it passed or filled and the measurement it received for that circuit board. the box in the middle of the image is where you can set the stage or zero it before the program can run and also it is where you can control the camera lights of the machine to see the image better when you are looking for things like a circle on the circuit board.

Image 6



Coordinate Measuring Machine

7. Flow-chart of execution



8. User Setup and Operation

1. Plug in the CMM machine power supply and plug in computer

2. Make sure the green light on top of camera of the CMM is turn on like in image 7 in the appendixes section.

3. Hit the green button on the control panel to turn on the machine and computer, the black to turn off, and red button for emergency shutdown as showed in image 7 in the appendixes section.

4. When the log on screen appears, no password is required just click ok to log in

5. To get the machine to run in the VIEW software you must first zero stage every time you want to run a new program on it.

6. For the Element software, you must zero the stage too before the machine can run.

7. All View files and Element files that have been programed before can be find in the C drive under View folder or Element folder.

8. Before turning off the machine you must zero the stage or the machine will not run again until you do and the program will not close.

Coordinate Measuring Machine

9. Test Plan

Test Description	Computer turns on and talks to the coordinate measuring machine and receives information from the PC and the software program.		
Steps	**Actions**	**Expected Results**	**Results**
1.	Turn on monitor	monitor should turn on and display No signal received and then go to sleep	The monitor turned on
2.	Push green start button on desktop	Monitor wakes up and waits for log in information to be entered	The computer and CMM turns on
3.	Log in screen	Means the power supply can support the new components	The log in screen appeared
4.	Enter log in information	Enters the main screen of the PC	Enter main screen
5.	Main screen displays	Windows 2000 OS interface	Windows 2000 OS
6.	Turn on CMM by pushing the big green button on the CMM	Computer should receive a new hardware signal message	Turned PC and CMM on
7.	Go to start and click the VIEW Metrology program	View metrology program opens up	The software turns on
8.	Open a VIEW Metrology file program	programs file interface displays	The program runs
9.	Run the program file	CMM should be receiving the signal	The CMM is measuring
10.	CMM should be running	The circuit board that was build should match the instructions on the program file on the VIEW Metrology Software when it's completed	The results are displayed and shows pass fail and measurement result

Coordinate Measuring Machine

10. CONCLUSIONS AND RECOMMENDATIONS

When going through this report a person should be able to repair a non-functioning coordinate measuring machine that hasn't been working. This report talks about the design overview of the PC that DivSys used for a different project but could be used for the CMM machine if the software and drivers could be obtained. Also, talks how we got the coordinate measuring machine to work again using the old Computer that runs on windows 2000. And the report also talked about the construction, cost, terms, parts, coding and testing phases of the coordinate measuring machine, PC, and the machine's electrical components of the project so people working on a similar project will have a good idea on what is required on getting a project like this done.

Some recommendations we have other project like this is check the hardware first before doing anything else, because you might be dealing with a faulty machine component. Make sure all the lights inside the machine are turned on, and that warning lights aren't showing. If the lights aren't turned on, then something isn't getting the energy it needs to function, and that in turn will cause the entire machine to not work properly. Also, if the computer needs to be replaced, make sure you have a plan to install all the previous software on the new computer, and that the drivers and program files are available to you before you start working.

Coordinate Measuring Machine

NOTES

1. CMM = coordinate measuring machine
2. Make sure drivers can be obtained
3. VIEW Metrology Software is obsolete
4. Need similar software to VIEW Metrology Software to run CMM
5. Check CMM machine for lights to make sure the machine itself works

Coordinate Measuring Machine

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DivSys line of code for one of their circuit boards

Coordinate Measuring Machine

APPENDIXES

A. Cost

A cost chart of everything that is ordered

MATERIAL	QUANTITY	MATERIAL LIST PRICE	Shipping price	Total Material price
PCI Express to PCI Adapter Card	1	36.99	0	36.99
12-Inch LP4 to 2x SATA Power Y Cable	1	3.67	2.99	6.66
CPU power cable Adapter	1	2.99	3.99	6.98
Asus AM3+ Motherboard	1	54.99	0	54.99
Kingston HyperX Fury Series 8GB	2	30.00	0	60.00
AMD FX-8320 Processor	1	154.99	0	154.99
Microsoft Windows 7 Professional 64-Bit Operating System	1	139.99	6.99	146.98
Seagate Desktop HDD Hard drive	1	49.99	2.00	51.99
Power supply	1	74.99	2.00	76.99
Total	10	548.60	17.97	596.57
Total Price	614.54			

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Image 7 The CMM Machine

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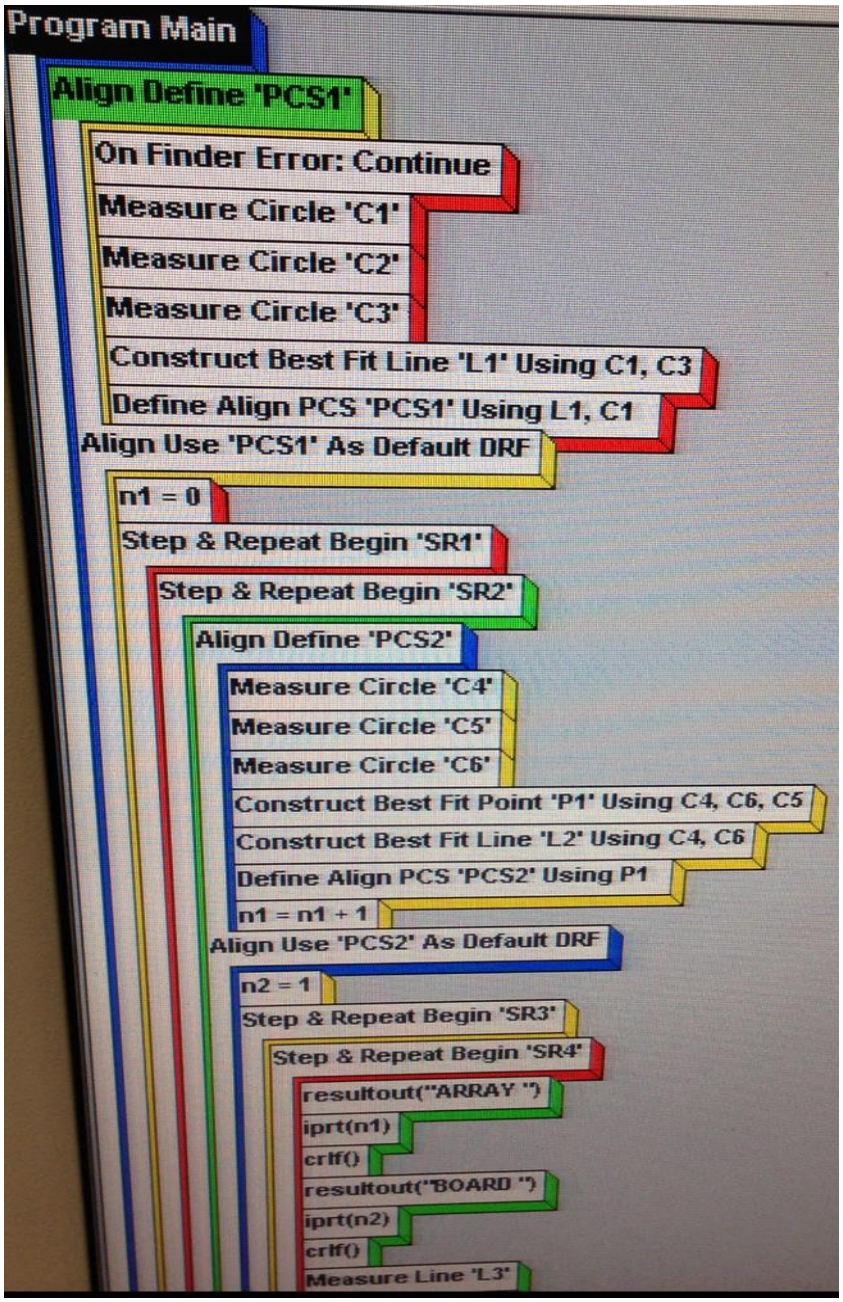
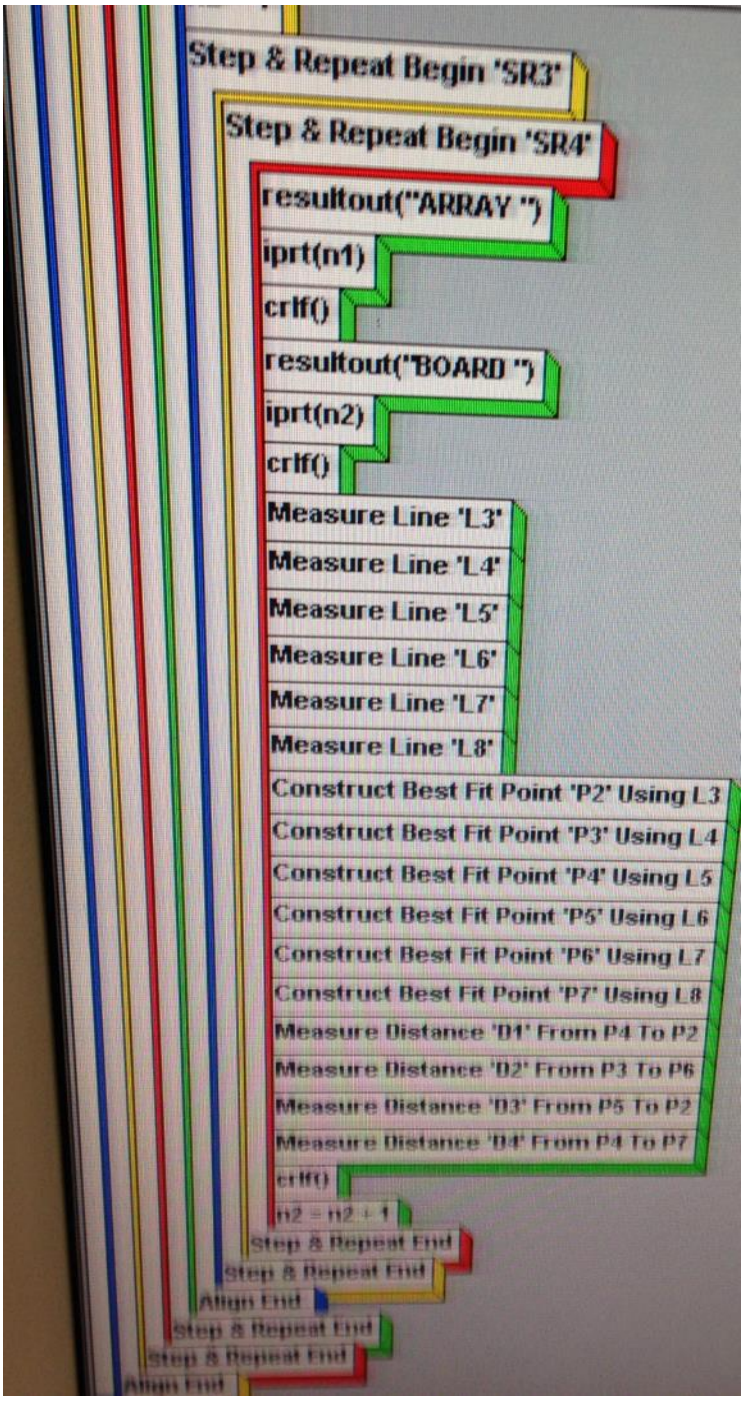
DivSys VIEW Code Metrology Software

Image 8



Coordinate Measuring Machine

Image 9



Coordinate Measuring Machine

The computer motherboard and cables

Image 10

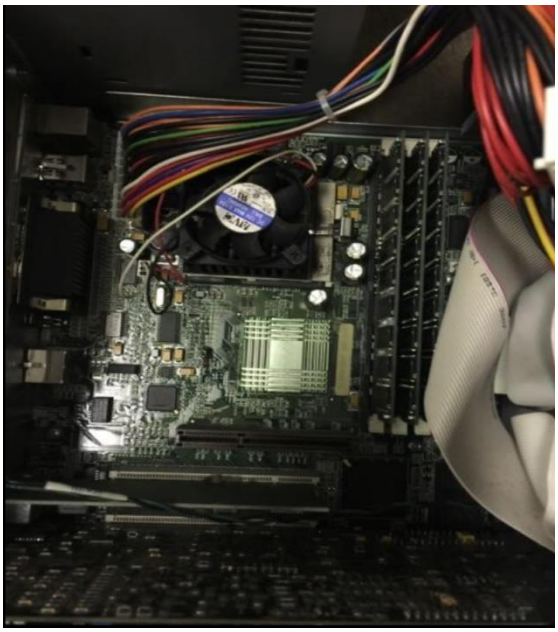


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Image 11

Coordinate Measuring Machine

CMM information

Image 12

Image 13

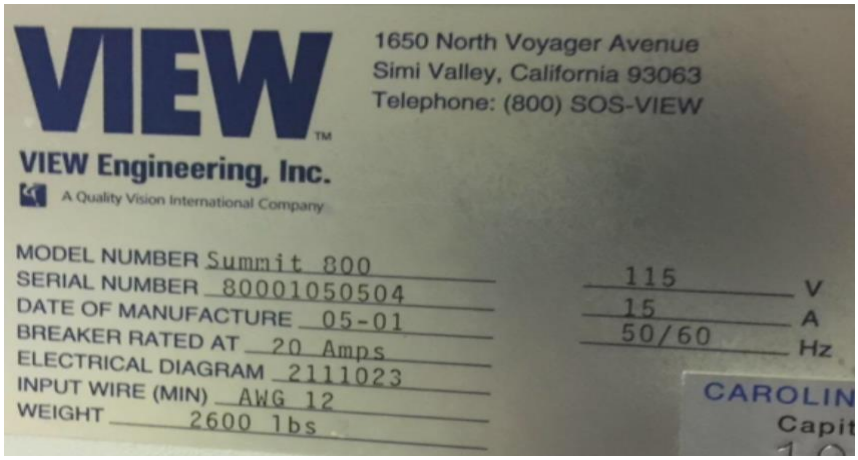

Image 14: the back of the CMM

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Image 15: XYZ axis controls